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ABSTRACT

Tenth grade biology students were randomly assigned to three groups of 36 students each. Each group was presented with the same learning materials. The material was in a printed format for one group, one group was read the material, and the third read the material while it was read to them. All groups were given a printed retention test, and, when the Verbal Reasoning Test score of the Differential Aptitude Tests was used as a covariate, there were no differences among the scores of the groups. The results are consistent with Broadbent's model of the perceptual system as a single channel system and have implications for designers of audio-visual instructional systems. (AL)

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THE EFFECTS OF UTILIZING SIMULTANEOUS AUDIO AND PRINTED MEDIA IN SCIENCE

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INTRODUCTION

The purpose of this study was to examine the question: Is there a learning advantage in presenting science verbal information using simultaneous audio and printed media in comparison to using singularly either audio or printed media? In other words, if a student learned by both listening and reading the same information at the same time, would this technique produce a more desirable outcome? The objective of this study was not to provide developers of instructional materials with a new audiovisual production rule or a "practical" generalization. Unfortunately, this is the expectation of some developers of multi-media systems. Instead, research of this variety can help to provide a better foundation from which a more competent developmental decision can be made. If a significant learning advantage exists, possibly developers of instructional materials in science should be considering this multimedia technique. For example, those programs and courses using audio tapes as an instructional medium would be in an excellent position to utilize the technique, discriminatingly. Currently, this kind of parallelism of information is only used in the administration of tests (Travers 1970). This technique requires that the directions be read orally by the examiner while the person taking the test silently reads the same directions to himself from a printed copy.

Textbooks specifically concerned with audio-visual devices have long advocated the presentation of redundant information by using audio-visual media (Travers 1964). In fact, practically all of the literature in the audio-visual field of the past has strongly supported the concept of multiple input of the same information (Travers 1970). Specifically, this literature has supported the technique that allowed students to learn by both listening and reading simultaneously presented redundant verbal information. Some of the theoretical advantages supporting this concept are: (1) If the subject receives more than one encounter with the same information, this multiple bombardment would have the same effect as a series of learning trials; (2) The subject will more easily remember and/or understand the learning materials if given the option of learning by listening, learning by reading, or learning by a combination method; (3) A more powerful outside distractor would be necessary to divert the learner from the learning materials. Therefore, a dual media system would result in the student paying more attention to the presented material; (4) If a subject was presented materials utilizing these multi-media channels, this would induce him to be relatively more motivated because of the uniqueness of the media delivery system.

Smith, Schagrin and Poorman (1967) examined multi-media systems with particular emphasis on instructional programs developed in science education. They concluded that many claims have been made regarding the effects of multi-sensory systems on learning. However, little rigorous research has been performed on these so-called rules that are intended to guide the developers of multi-media systems. These authors found this lack of properly supported theory was a hardship to the development of a multi-media system pilot project adjunct to Harvard Project Physics. The author of this paper has investigated only one of these theories as it relates to instructional materials in science.

Duker (1965), who has reviewed the research on listening in the April, 1964, Review of Educational Research and has written a book entitled Bibliography on Listening, hypothesized that more learning will occur if a combination of visual and auditory presentation of verbal material is utilized. This statement was one of "eleven generalizations" developed by Duker in his attempt to clarify the

conflicting information found in listening and reading research. Hartman (1961a, 1961b) also concluded that the combinational delivery technique is more effective in producing learning than is presenting the same information in either channel alone. However, more recent research by Van Mondfrans and Travers (1964) and Severin (1967b) has not supported these contentions. Conway (1967) also has reviewed this issue. He reported "mixed and contradictory findings". Conway attributed this discrepancy to "serious methodological flaws that run through many of the studies, e.g., no test of significance, absence of control over such factors as the time of exposure of the material to be learned, and the selection of materials".

Most investigators examining similar questions have used learning materials consisting of independently arranged verbal information. Since science curricula are composed of meaningful prose, the generalization of these experimental studies (such as Hartman, Van Mondfrans and Travers and Severin to mention a few) to meaningful prose in science education remains a moot point. Most studies which have investigated multi-media questions using prose material have neglected certain experimental methodological considerations according to a review of multi-media research conducted by Briggs, Campeau, Gagne and May (1967). The following characteristics were among those found in the literature by Briggs et al: (1) studies usually combined media with conventional teacher instruction resulting in questionable stated conclusions; (2) there were few controls for differences in prior knowledge; (3) intact classes were used rather than selecting individuals by random sampling; (4) materials used were off-the-shelf versions and not designed specifically for research purposes; and (5) the teacher played an important role in most of the treatments. This study was designed to overcome the experimental and statistical problems stated above.

THE EXPERIMENT

One hundred and nine tenth grade biology students were randomly assigned to three treatment subgroups, resulting in about 36 subjects per subgroup. A variation of the posttest only control groups design was used. These subgroups were identifiable by the group-paced delivery technique utilized in the learning session. The printed subgroup read the text. The audio subgroup listened to the text read aloud. The audio-printed subgroup utilized a simultaneous combination of these two delivery techniques. All subjects were administered the same printed retention test. The subjects received a general orientation and some practice learning material similar in content and in presentation on the day preceding the actual experiment. A programmed text format was used in the learning session. The reason for utilizing this programmed text format was to insure the cooperation of the subject, to simulate more closely the experimental conditions among the three subgroups, and to present a format that would allow all subjects a better opportunity to more actively interact with the material (as opposed to the traditional experimental method of merely reading and/or listening to the presented verbal information).

Special materials consisting of three hypothetical concepts in biology and an accompanying retention test were developed for this study. These materials were developed in close association with Dr. Addison E. Lee, Director, Science Education Center, The University of Texas. The retention test items were

designed to require the subjects to use higher level mental processes. The retention test required all students to learn new information and subsequently understand, compare, contrast and apply the concepts presented in the learning sessions. These materials were primarily developed to minimize the effect of certain student entering behaviors and to prevent the verbal-printed component from singularly dominating the sensory channels to the brain. Hartman (1961b) and Duker (1965) have stated that ordinarily a printed medium can best communicate moderately complex verbal infoomation, in contrast to an audio medium.

A pilot program involving thirty-three subjects was administered in a near-by school. This pilot program was conducted to determine the appropriateness of the administrative aspects of the experimental procedure and to subject the resulting test data to an item analysis. The item content of the retention test used in the experimental phase was based upon the results of this analysis.

The subgroups utilizing the audio and the combinational delivery techniques were placed in one classroom; the printed delivery technique subgroup was presented in another classroom. Because of the lack of facilities at the high school, the subjects were aware of the three different learning treatments. Both groups received all instructions over separate tape recorders. Apparently, all students were able to hear the tape recorders at all times. The students apparently were able to understand the instructions. These conclusions were drawn as a result of carefully surveying the subjects periodically throughout the learning session.

Analysis of Covariance was used to test the probability of significant difference between the adjusted means. The Verbal Reasoning Test scores of Differential Aptitude Tests served as the covariate scores. Analysis of covariance indicated that there was no learning advantage in presenting the information using a simultaneous combination of audio and printed media. In other words, the probability value that the difference between the observed adjusted means occurred by chance did not reach the .05 level of significance. In fact, the probability value generated by the COVARY program was .99. Considering the sample size, the experimental design, and the administrative procedures, there was little likelihood that the differences among the subgroups would have been of any consequence.

All subjects were informally asked which learning technique, if any, they preferred. Most subjects claimed that the combination media was "best". No student volunteered a theoretical explanation. The remaining subjects were approximately split evenly as to whether the audio or the printed media delivery technique was "best". However, it is recognized that this kind of survey is not necessarily experimentally sound and one must be cautious in making interpretations from it.

The subjects were aware of the three different treatments during the learning session. If significant differences would have been detected, the subject's awareness of the different treatments could have been considered a rival explanation for the differences. It is doubtful that the subject's awareness of the varying treatments contributed to no significant difference, especially if their informally indicated preferences are considered.

None of the subjects indicated that learning a hypothetical science lesson negatively altered their usual learning or "test-taking" performance. In fact, many subjects voluntarily indicated that they enjoyed learning the hypothetical ideas.

CONCLUSIONS

The finding that there was no learning advantage in presenting redundant verbal information using a simultaneous combination of audio and printed media is consistent with recent research. Van Mondfrans and Travers' explanation of similar experimental results were supported by Broadbent's theoretical model of the perceptual system as a single channel system. These investigators contended that the redundant information presented through one of the two media never gained access to the brain. Apparently, the optimal medium depends upon both the information presented and the individual learner. Severin's explanation for no learning advantage can be found in the cue summation theory which states that if more learning is to take place, additional information or cues must be provided by one of the media components. Severin (1967a) found no advantage in the simultaneous presentation of redundant material utilizing verbal audio and verbal-printed channels.

The results of this study lend credence to the applicability of both Van Mondfrans and Travers, and Severin's works. Furthermore, the results raise questions concerning the potential of the technique under investigation.

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